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Title:

METHOD FOR SYNTHESIZING OLEFINIC HYDROCARBONS

The invention concerns a method for the production of olefinic hydrocarbons, especially by dehydrogenation of paraffinic hydrocarbons.

A method is known for the production of olefinic hydrocarbons by dehydrogenation of paraffinic hydrocarbons circulating in a pseudo-fluidized catalyst bed in a reactor-regenerator system. Heat is supplied to the reaction zone by a solid, inert heat carrier circulating together with the catalyst through the regeneration zone, significantly less catalyst being present in the circulating mixture than heat carrier (weight ratio 1:10), which does not permit satisfactory results to be achieved by the dehydrogenation.

For the purpose of reducing the degree of circulation of catalyst and increasing the holding time of the catalyst in the reactor it is proposed that

a circulating mixture of catalyst and solid inert heat carrier containing 30-60 wt.% catalyst be fed to regeneration.

The proposed process is illustrated by the drawing.

The dehydrogenation is conducted in a fluidized bed of catalyst in the reactor 1 which is supplied with raw material through line 2. The greater part of the heat necessary for the reaction is supplied to the reactor by the solid inert heat carrier which is heated in the regenerator apparatus 3 located at a higher level and moves through the riser/standpipe 4 into the reactor in the form of a "falling" film. The particles of the heat carrier have larger dimensions and higher density than the particles of the catalyst, thanks to which they settle out in the fluidized bed of the latter and are separated from it. In order to achieve sufficiently complete separation of the catalyst and the heat carrier the reactor must have a special zone from which the catalyst particles entrained by the flow of heat carrier are returned to the fluidized bed. In the proposed process a reactor with a separation zone 5 is used, but a reactor of any other suitable design may also be used

The catalyst need not be totally separated from the heat carrier since a certain part of the catalyst must be moved from the reactor to the regenerator in order to remove the carbon deposits. In this way a constant content of the latter is maintained on the catalyst situated inside the reactor. Therefore the heat carrier being removed from the reactor

includes a certain quantity of catalyst. It is removed from the separation zone through the riser 6 and is fed into a metering device 7 of any suitable design. Then after pneumatic transportation through the pneumatic transportation line 8 the heat carrier is fed to the regenerator which is also supplied with fuel through conduit 9 and with air through conduit 10. The heat carrier is heated and the catalyst regenerated in the fluidized bed. The smoke gases are sent through conduit 11 from the regenerator to the apparatus for utilization of the heat and a mixture of gases from the reactor through conduit 12 to cooling and separation.

The results of the calculation of the circulation of the heat carrier for different temperatures in the heating apparatus are presented in the table. The temperature in the reactor is 570°C, the heat capacity of the heat carrier and catalyst 0.25 kcal/kg. The calculations were performed for the degree of conversion of butane of 35%, corresponding to heat utilization in the reactor of 175 kcal/kg of initial butane.

Heat carrier intake temperature, °C.	Total circulation of heat carrier and catalyst, kg/kg of the initial butane
620	14.0
650	8.75
700	5.4

In order to realize the proposed process a certain increase in the temperature in the regenerator is necessary. Since the regeneration is conducted in the presence of a significant quantity of inert heat carrier which promotes the removal of heat from the regeneration zone, the above noted increase in temperature is entirely possible.

As a heat carrier one may use a granular refractory material, preferably with spherical granules. From the results of tests on a pilot plant corundum bead is a suitable material. The size and density of the granules of heat carrier should be such that the pseudofluidization number of the heat carrier in the reactor is within the limits from 1.05 to 1.15. This condition must be satisfied in order to achieve the required full degree of separation in the fluidized bed and catalyst in the reactor.

Example

The dehydrogenation of butane into butylene is usually conducted under the following conditions:

Temperature in reactor, increase,°C	570
Temperature in regenerator,°C.	600-610
Volume flow rate, h-1	120
Circulation of catalyst kg/kg of butane	16-17
Holding time of catalyst in reactor, min	10

According to the data in the literature the maximum permissible content of carbon deposits on the catalyst is 0.4 wt.%, their yield with respect to raw material is 1.5 wt.%. On the basis of these data the operating mode of the dehydrogenation apparatus for butane by the proposed process is as follows:

Temperature in reactor, °C.	570
Temperature in regenerator, °C	650
Volume flow rate, h^{-1}	120
Total circulation, kg/kg butane:	8.75
including	
Catalyst	3.75

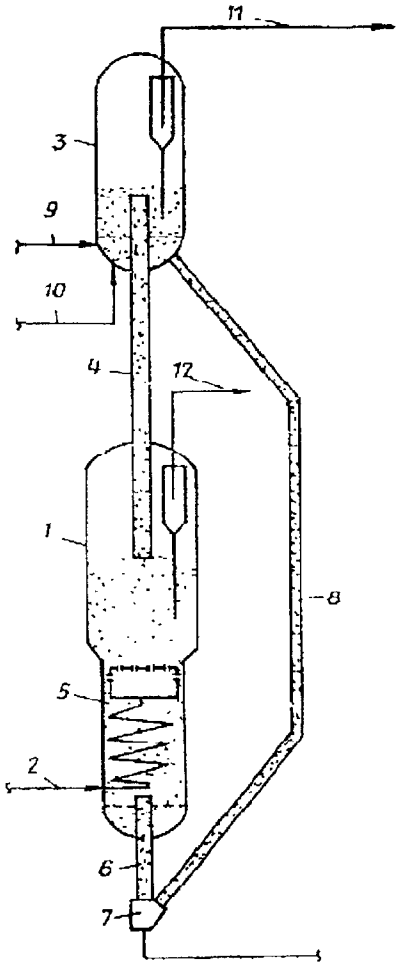
Heat carrier	5.00
Holding time of catalyst in reactor, min	41

A comparison of the operating modes reveals that the proposed process permits a reduction in the circulation of catalyst by 4-4.5 times, an increase in the holding time of the catalyst in the reactor and a reduction in the diameter of the transporting lines by 1.3-1.4 times. The increase in holding time of the catalyst in the reactor permits a increase in the yield of the sum of butenes and divinyls up to 36-38% and in the selectivity of the process up to 80-84%.

As the heat carrier corundum bead is used with a bulk weight of 1600 kg/m[3]. At a vapor velocity in the reactor of 0.4 m/sec. the size of the granules of such a heat carrier is 1.2 mm. In this case the critical velocity is 0.364 m/sec and the pseudofluidization number is 1.1.

Claim

Method for the production of olefinic hydrocarbons by dehydrogenation of paraffinic hydrocarbons in a pseudofluidized bed of a mixture of catalyst with a solid inert heat carrier with subsequent feeding of the above-noted mixture to regeneration and its recirculation into the reaction zone, characterized the fact that for the purpose of reducing the degree of circulation of catalyst, a mixture containing 30-60 wt. % catalyst is sent to regeneration.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